APPENDIX 15B

Wetland Calculations

Appendix 15B: Wetland Calculations

15B.1 Calculation of Variables

1. **V_{mod}** is a categorical measure of the disruption of groundwater and surface water hydrology within a wetland and its adjacent, 300-foot perimeter (2,000-foot buffer used for $FCI_{Habitat}$ and $FCI_{Connectivity}$).

   To calculate V_{mod}, identify all human-made disturbances (such as roads, berms, and ditches) that alter hydrology by either drying or storing water. Assign each modification a coefficient based on severity:

   - 0.00 = 1, Extreme (for example, four-lane paved highway, ditches more than 3 feet deep)
   - 0.50 = 2, Moderate (for example, two-lane paved road, ditches 1 foot to 3 feet deep)
   - 0.75 = 3, Slight (for example, near-grade roads, ditches less than 1 foot deep)
   - 1.00 = 4, None

   Multiply the percentage of the wetland functional unit affected by each modification by its coefficient. Sum them for a composite score (see example).

   Example calculation:

   65% of wetland is unmodified (65% × 1.00 = 0.65)
   20% of wetland is slightly modified (20% × 0.75 = 0.15)
   15% of wetland is extremely modified (15% × 0.00 = 0.00)
   $V_{mod} = 0.65 + 0.15 + 0.00 = 0.80$

2. **$V_{vegstruct}$** is one measure of surface roughness. It is an indicator of vegetation structure as a function of native and non-native species, based on wetland type or subclass.

The $V_{vegstruct}$ variable described in this chapter is the sum of the native species score and the score for herbaceous cover, divided by 2 (Keate 2001). Vegetation cover is determined at 6 inches above ground surface. The native species score is determined by dividing the number of individuals of the five dominant, native species by 5. If there are less than five dominant species, the total number of species is used as the divisor (for example, if there are only four dominant, native species, the total number of individuals of those species is divided by 4).

Herbaceous cover scores are calculated by subclass, and scores are based on the relative level of salinity (see the example below in Table 15B.1-1):

Table 15B.1-1. Example of Calculating Herbaceous Cover Scores

Subclass	Salinity	Actual Cover	Score
Slope wetland subclasses	< 8dS	≥ 0.83	1
	< 8dS	< 0.83	(2.87 × cover) – 1.40
	> 8dS	≤ 0.71	1
	> 8dS	> 0.71	3.46 × cover
Depressional wetland subclasses	< 8dS	≥ 0.82	1
	< 8dS	< 0.82	(0.43 × cover) + 0.39
	8dS – 16dS	≥ 0.76	1
	8dS – 16dS	< 0.76	(0.39 × cover) + 0.37
	> 16 dS	≤ 0.61	1
	> 16 dS	> 0.61	2.98 – (3.28 × cover)

Example calculation:

Total number of dominant species = 5
Total number of native dominant species = 2
Native Species Score = 2 ÷ 5 = 0.40

For a depressional wetland with a salinity of 10 dS and an actual cover of 0.65:

Modified Herbaceous Cover Score = (0.39 × cover) + 0.37 = (0.39 × 0.65) + 0.37 = 0.62

$V_{vegstruct}$ = (Native Species Score + Modified Herbaceous Cover Score) ÷ 2

$V_{vegstruct} = (0.40 + 0.62) \div 2 = 0.51$

3. **V_{runoff}** is the average amount of overland flow that reaches the wetland functional unit. It is affected by land uses surrounding the wetland that reduce soil permeability and alter the quantity and timing of water delivery to the wetland. V_{runoff} coefficients were calculated from one Florida study and tabulated in a working paper by Nnadi (1997).

   To calculate V_{runoff}, identify all land uses within a 300-foot perimeter of the wetland functional unit and determine the percentage of the total area that each use occupies. Multiply each percentage by its land-use coefficient (see Appendix 15B, Wetland Calculations). Sum them for a composite score (see example).

   Example calculation:

   50% of perimeter is rotational grazing (50% × 0.96 = 0.48)

   34% of perimeter is field crops (34% × 0.95 = 0.32)

   16% of perimeter is light-intensity commercial development (16% × 0.19 = 0.03)

   $V_{runoff} = 0.48 + 0.32 + 0.03 = 0.83$

4. **$V_{runoffin}$** measures the impact of land uses within the wetland functional unit by surface roughness (as related to plant structure) and water infiltration and flow over wetland soils. $V_{runoffin}$ coefficients were calculated from one Florida study represented by a tabulation of multiple studies throughout the U.S. by Nnadi (1997).

   To calculate $V_{runoffin}$, identify all land uses within the wetland functional unit and determine the percentage of the total area that each use occupies. Multiply each percentage by its land-use coefficient (see Appendix 15B, Wetland Calculations). Sum them for a composite score (see example).

   Example calculation:

   62% of wetland is waterfowl management area (62% × 0.86 = 0.53)
   21% of wetland is rotational grazing (21% × 0.96 = 0.20)
   17% of wetland is dirt road (17% × 0.71 = 0.12)
   $V_{runoffin} = 0.53 + 0.20 + 0.12 = 0.85$

5. **$V_{disload}$** is a measure of the loading of the wetland functional unit with elements and compounds from land uses on adjacent lands within a 300-foot perimeter. $V_{disload}$ coefficients were calculated from studies conducted throughout the U.S. and tabulated in a working paper by Nnadi (1997).

   To calculate $V_{disload}$, identify all land uses within the 300-foot perimeter and determine the percentage of the total area that each use occupies. Multiply each percentage by its land use coefficient (see Appendix 15B, Wetland Calculations). Sum them for a composite score (see example).

   Example calculation:

   68% of perimeter is waterfowl management area (68% × 0.86 = 0.58)

   21% of perimeter is rotational grazing (21% × 0.96 = 0.20)

   11% of perimeter is sewage treatment lagoon (11% × 0.61 = 0.07)

   $V_{disload} = 0.58 + 0.20 + 0.07 = 0.85$

6. **$V_{diswetuse}$** is a measure of the loading of the wetland with elements and compounds from land uses within the wetland functional unit. $V_{diswetuse}$ coefficients were calculated from studies conducted throughout the U.S. and tabulated in a working paper by Nnadi (1997).

   To calculate $V_{diswetuse}$, identify all land uses within the wetland functional unit and determine the percentage of the total area that each use occupies. Multiply each percentage by its land-use coefficient (see Appendix 15B, Wetland Calculations). Sum them for a composite score (see example).

   Example calculation:

   54% of wetland is heavy grazing (54% × 0.87 = 0.47)
   36% of wetland is forested (36% × 1.00 = 0.36)
   10% of wetland is high-traffic highway (10% × 0.43 = 0.04)
   $V_{diswetuse} = 0.47 + 0.36 + 0.04 = 0.87$

7. **$V_{susload}$** is a measure of the relative volume of total suspended solids (TSS) carried into the wetland functional unit surface water from the surrounding landscape. $V_{susload}$ coefficients were calculated from studies conducted throughout the U.S. and tabulated in a working paper by Nnadi (1997).

   To calculate $V_{susload}$, identify all land uses within the 2,000-foot perimeter and determine the percentage of the total area that each use occupies.

Multiply each percentage by its land-use coefficient (see Appendix 15B, Wetland Calculations). Sum them for a composite score (see example).

Example calculation:

74% of perimeter is low-density rural development (74% × 0.98 = 0.73)

16% of perimeter is surface solid waste (16% × 0.61 = 0.10)

10% of perimeter is dirt road (10% × 0.97 = 0.10)

$V_{susload} = 0.73 + 0.10 + 0.10 = 0.93$

8. **$V_{suswetuse}$** is a measure of the relative volume of TSS carried into the wetland functional unit surface water from land uses within the wetland. $V_{suswetuse}$ coefficients were calculated from studies conducted throughout the U.S. and tabulated in a working paper by Nnadi (1997).

To calculate $V_{suswetuse}$, identify all land uses within the wetland and determine the percentage of the total area that each use occupies. Multiply each percentage by its land-use coefficient (see Appendix 15B, Wetland Calculations). Sum them for a composite score (see example).

Example calculation:

35% of wetland is field crops (35% × 1.00 = 0.35)
33% of wetland is rotational grazing (33% × 0.98 = 0.32)
32% of wetland is range (32% × 1.00 = 0.32)
$V_{suswetuse} = 0.35 + 0.32 + 0.32 = 0.99$

15B.2 References

Keate, N.S.

2001 Functional Assessment of Great Salt Lake Ecosystem Slope and Depressional Wetlands. 2001 Model. Utah Division of Wildlife Resources, Salt Lake City.

Nnadi, F.N.

1997 Land Use Categories Index and Surface Water Efficiencies Index. University of Central Florida, Orlando.

15B.3 Sample FCI Calculations

Table 15B.3-1. Sample Baseline FCI Scores for Salt Lake County

Function	Final FCI Score	Calculations
Wetland Functional Unit 16		
FCI Hydro	0.289	$=\sqrt{V_{mod} \times V_{runoff}} = \sqrt{0.218 \times 0.382}$
FCI InHydro	0.431	$=\frac{V_{vegstruct} + V_{runoffin}}{2} = \frac{0.610 + 0.251}{2}$
FCI Dissolved	0.648	$=\frac{V_{diswetuse} + V_{disload}}{2} = \frac{0.658 + 0.639}{2}$
FCI Particulates	0.229	$=\frac{\frac{V_{susload} + V_{suswetuse}}{2} + V_{mod}}{2} = \frac{\frac{0.335 + 0.144}{2} + 0.218}{2}$
Wetland Functional Unit 20		
FCI Hydro	0.694	$=\sqrt{V_{mod} \times V_{runoff}} = \sqrt{0.505 \times 0.953}$
FCI InHydro	0.919	$=\frac{V_{vegstruct} + V_{runoffin}}{2} = \frac{0.840 + 0.997}{2}$
FCI Dissolved	0.975	$=\frac{V_{diswetuse} + V_{disload}}{2} = \frac{0.989 + 0.960}{2}$
FCI Particulates	0.745	$=\frac{\frac{V_{susload} + V_{suswetuse}}{2} + V_{mod}}{2} = \frac{\frac{0.971 + 0.999}{2} + 0.504}{2}$

Table 15B.3-2. Sample Baseline FCI Scores for Utah County

Function	Final FCI Score	Calculations
Wetland Functional Unit 1		
FCI Hydro	0.769	$=\sqrt{V_{mod} \times V_{runoff}} = \sqrt{0.662 \times 0.894}$
FCI InHydro	0.905	$=\dfrac{V_{vegstruct} + V_{runoffin}}{2} = \dfrac{0.860 + 0.951}{2}$
FCI Dissolved	0.928	$=\dfrac{V_{diswetuse} + V_{disload}}{2} = \dfrac{0.947 + 0.909}{2}$
FCI Particulates	0.811	$=\dfrac{\dfrac{V_{susload} + V_{suswetuse}}{2} + V_{mod}}{2} = \dfrac{\dfrac{0.941 + 0.979}{2} + 0.662}{2}$
Wetland Functional Unit 24		
FCI Hydro	0.184	$=\sqrt{V_{mod} \times V_{runoff}} = \sqrt{0.139 \times 0.245}$
FCI InHydro	0.630	$=\dfrac{V_{vegstruct} + V_{runoffin}}{2} = \dfrac{1.000 + 0.260}{2}$
FCI Dissolved	0.653	$=\dfrac{V_{diswetuse} + V_{disload}}{2} = \dfrac{0.690 + 0.615}{2}$
FCI Particulates	0.162	$=\dfrac{\dfrac{V_{susload} + V_{suswetuse}}{2} + V_{mod}}{2} = \dfrac{\dfrac{0.209 + 0.160}{2} + 0.139}{2}$